

NPSAT1 VISIM Data Processing

Introduction

NPSAT1 is a low-cost, technology demonstration satellite hosting a number of experiments. Commercial, off-the-shelf (COTS)-based technology will be implemented with custom designs to offer a low-cost command and data handling (C&DH) subsystem building on commercial, desktop PC architecture and standards-based specifications. In addition to an experimental C&DH subsystem, NPSAT1 will demonstrate the use of non-volatile ferroelectric RAM which is inherently radiation-tolerant and lithium-ion polymer batteries, state-of-the-art technology that will be employed offering high energy density (Watt-hr/kg) for space applications.

Experiments on-board NPSAT1 include two Naval Research Laboratory (NRL) payloads. The coherent electromagnetic radio tomography (CERTO) experiment and a Langmuir probe. The CERTO experiment is a radio beacon which, in concert with ground station receivers, is used to measure total-electron-content (TEC) in the ionosphere. The Langmuir probe will augment CERTO data by providing on-orbit measurements. The other experiments are of NPS origin. These include a novel design for a spacecraft computer board, a COTS visual imager (VISIM), and some micro-electromechanical systems (MEMS)-based rate sensors.

Description of Thesis Topic

The NPSAT1 VISIM produces raw data in a pattern known as a Bayer Pattern. There is a simple Bayer to RGB conversion which allows human visualization of the image data. Bayer and RGB representations of images are described using large data files (313 kbytes and 940 kbytes). Lossless compression of these files may achieve a 2:1 ratio. It is expected that the NPSAT1 VISIM will acquire many more images (and store them temporarily on the spacecraft) than it will download (in raw data format) to the ground. Therefore, using a lossy compression scheme to allow previewing the images on the ground before the actual raw data is downloaded will be necessary. An obvious choice, due to the fact that the VISIM images are photographic-like, is JPEG. However, other compression formats are possible and need researching, including the new JPEG 2000.

The scope of this thesis is to define and research various compression techniques and compare them. Implementation, in computer code, of encoded techniques is required. In addition, an automated method of obtaining Bayer pattern images and producing lossy images is necessary. The spacecraft software will operate under a Linux (2.2.x) system using a 386-based computer system. However, development will be done on a standard (and modern) desktop computer.

Proposed Outline

- NPSAT1 Introduction
- VISIM Description and Requirements
- Compression schemes and tradeoffs
- Compression implementations

- Conclusions & Recommendations
- Appendix of Test Results and Test Data

Suggested References

- NPSAT1 PDR Slides
- NPSAT1 VISIM Slides (see Jim Horning)
- Bayer to RGB conversion software (see Jim Horning)
- *Bayer Pattern Processing*, <http://www.dvcco.com/rgb.htm>